AN ONLINE TECHNOLOGY INTERVENTION TO INCREASE MATERNAL FRUIT AND VEGETABLE CONSUMPTION: SALUBRIOUS SEED

by

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ABSTRACT

Mothers of young children play a significant role in shaping their young children's fruit and vegetable (FV) intake. Internet based interventions are a convenient and accessible method for delivering health education. This pilot study assessed the following two research questions: 1) Is mobile technology a feasible and acceptable way to increase nutrition knowledge and cooking confidence among mothers of young children; and 2) Will increasing nutrition knowledge and cooking confidence increase the daily number of FV servings that mothers of young children consume? Findings indicated that mobile technology is a feasible and acceptable way to increase nutrition knowledge, cooking confidence, and FV consumption. Furthermore, a higher adherence for the text-messaging component than for the blog was observed. A significant association between increased cooking confidence and increased FV intake was also observed. Outcomes from this study can be utilized to develop larger interventions and be incorporated into existing nutrition programs involving mothers such as Healthy Child Care Georgia.

INDEX WORDS: Maternal dietary influence, fruits and vegetables, mobile technology, online intervention, social cognitive theory, self-efficacy, cooking skills, nutrition knowledge, mothers, parents, Georgia

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CHAPTER 1

INTRODUCTION

The prevalence of children who are overweight and obese increases as they get older [1]. Unfortunately, both immediate and future health risks exist as a consequence of childhood obesity [2]. Immediate risks include chronic diseases such as high blood pressure, impaired glucose tolerance, and fatty liver disease. Furthermore, children who are obese are more likely to be obese as adults [3]. Obesity in adulthood increases the risk for severe health conditions such as heart disease, type 2 diabetes, and cancer [4]. One of the causes of childhood obesity is poor dietary habits, a factor in which parents play a pivotal role [5, 6]. During early childhood, parents are role models [7, 8] and decision makers regarding the types of foods they make accessible to their children [6, 9, 10]. Moreover, mothers might have a greater impact than fathers on developing children's dietary habits due to the greater amount of time they may spend with their children, preparing food, and buying groceries [11]. However, many face-to-face interventions that target parents of young children struggle to maintain participant adherence [12]. This is likely due to the demanding schedule of many working adults. An alternative option to deliver nutrition interventions is mobile phone technology. In the US, the majority of people own a smartphone and can thereby easily access the internet at their own convenience [13]. Due to the accessibility and convenience of an online intervention, participant adherence is more likely to be retained[14].

This research study determined the feasibility and acceptability of using an online intervention to increase nutrition knowledge and cooking confidence among mothers of young

children. Additionally, this investigation assessed the effect of increasing nutrition knowledge and cooking confidence on the daily number of servings of fruits and vegetables (FV) that mothers of young children consume. Chapter 2 describes the background for the importance of FV consumption among adults and children. This includes an overview of obesity prevalence and parental influences on children's health behaviors. Furthermore, this section outlines the prevalence of FV intake in the US and factors that impact FV consumption such as cooking confidence, skills, and nutrition knowledge. Chapter 2 also describes the background for online technology interventions, especially those related to health behaviors and nutrition education.

Moving to the development of the web-based intervention, Chapter 3 covers the measures utilized to assess nutrition knowledge, maternal self-efficacy regarding cooking skills, and the feasibility and acceptability of the weekly blogs and the overall curriculum. The specific aims of this study were to: 1) determine the effect of increasing nutrition knowledge on the daily number of servings of FV of mothers of young children consume; 2) determine the effect of increasing self-efficacy for cooking skills on daily number of FV servings mothers of young children consume; and 3) determine the feasibility and accessibility of using an online intervention to increase nutrition knowledge, self-efficacy, and cooking skills among mothers of young children. We hypothesized that: 1) an online intervention is a feasible and acceptable way to increase nutrition knowledge and self-efficacy for cooking skills among mothers of young children; and 2) increasing nutrition knowledge and self-efficacy for cooking skills would result in an increase of the daily number of servings of FV that mothers of young children consume.

Specifically, to determine maternal FV intake the "Food Attitudes and Behavior Survey" was utilized. This measure provided examples of FV servings and then assessed daily intake for fruits and vegetables individually. To assess self-efficacy for cooking skills the "Cooking

Attitudes and Behavior Survey" was used. This survey asked participants to identify on a 5-point Likert Scale how confident they felt in performing specific cooking skills. In order to analyze mother's nutrition knowledge a modified version of the "General Nutrition Knowledge Questionnaire for Adults" was utilized. This questionnaire assessed knowledge of nutrients in specific foods and the diet disease relationships between certain nutrients. Finally, to determine feasibility and acceptability of the weekly lessons and overall program a short survey was developed. These surveys assessed mothers' perceptions of how the curriculum increased their nutrition knowledge, cooking skills, and cooking confidence. All surveys, except the feasibility and acceptability surveys, were distributed at baseline and post intervention via email. Chapter 4 will describe the individual results from each of these measures. Chapter 5 will discuss key findings of this study and future research needs in this area.

Lastly, it is noteworthy to point out that this research study was inspired by a larger study titled Healthy Child Care Georgia (HCCG). HCCG is a pilot study supported by the USDA-SNAP-Ed Program. The main goal of HCCG is to assess the feasibility of using a combined policy, systems, and environmental approach along with a direct classroom component. The direct classroom component is six weeks in duration and it utilizes the *Eat Healthy, Be Active* curriculum. The specific aims of HCCG include increasing teacher's knowledge of wellness best practices for obesity prevention in the ECE setting (i.e. "preschoolers are actively involved in mealtime activities…", "caregivers talk informally about healthy foods during meals, and reinforce children's internal cues of hunger and fullness every day") and assisting the teachers to select and adopt at least one of the best practice standards. This thesis study was inspired through direct observations in the classroom with HCCG. Despite teacher efforts (i.e. sending

newsletters home for parents about healthy eating), parents still packed poorly nutritious snacks for their children.

CHAPTER 2

LITERATURE REVIEW

Obesity Prevalence

According to the CDC, overweight and obesity are defined as "weight that is higher than what is considered a healthy weight for a given height." Specifically, a person is considered overweight when their BMI is equal to 25 but less than 30. A person is considered obese when their BMI is equal to or greater than 30 [2]. Worldwide obese and overweight populations have tripled since 1975. Thirty-nine percent of the world's adult population is overweight and 13% are obese [15]. In the United States (US), over 36% of the adult population is obese, 17% of children 2 to 19 years are obese, and 8.9% of 2 to 5-year-olds are obese [16, 17]. In Georgia, the prevalence of obesity in children 10 to 17 is 32.2%; ranking the state as number 18 in the nation overall [18]. Furthermore, in Georgia the obesity prevalence for children 2 to 4 years (WIC participants) is 13%; ranking the state as number 36 in the nation [19]. From these statistics, it is evident that the prevalence of obesity worsens as individuals age. Thus, interventions that focus on early childhood (0 to 5 years) are needed to prevent growing trends of childhood obesity.

Causes of Adult Obesity

The causes of obesity are complex [20], however several factors that can result in obesity are known. These factors include individual traits, like behavior and genetics, and societal influences such as the food and physical activity environment [21], food marketing, education, and skills [20]. Behaviors tied to the development of obesity include excess energy consumption

[22], lack of physical activity (PA), excessive sedentary time [23], and consumption of certain medications [20]. Genetics have also been found to play a role in the development of obesity. In 2005, the human obesity gene mapping project identified over 600 loci from single-gene mutations that are linked with an obese phenotype [24]. These findings along with other more recent evidence have helped the scientific community understand that genetics can predispose a person to be heavier [25]. However, a clear connection between obesity and a specific gene variant inherited within a family is rarely found [26]. It is more likely that obesity results from a complex interaction between multiple genes and environmental factors that are still not fully understood [26].

Causes of Childhood Obesity

The causes of childhood obesity are similar to those in adults and include factors such as behavior and genetics [5]. Two main behaviors that can result in obesity include high-calorie diets and physical inactivity [6, 27]. In the US, most children are not engaged in the recommended daily amounts of PA [28, 29]. Additionally, youth are exceeding their daily caloric needs. Evidence shows that the top 10 foods consumed by children 2 to 18 years are for the most part calorically dense and nutrient poor. These foods include: grain-based desserts, pizza, sodas, yeast bread, chicken, pasta, reduced-fat milk, dairy desserts, chips, and ready-to-eat cereals [30]. Parents have a pivotal role in constructing their children's dietary and activity habits, especially in early childhood.

Parental Influences

Before the age of 5, many eating and activity behaviors are learned in the home environment [31]. Parents of young children act as role models [7, 8] and decision makers for the type of food they make accessible for their children [6, 9, 10]. These choices have the potential

to influence what children learn about food and eating [27]. Thus, parents can impact their child's weight and their diet quality by having nutrition knowledge, modeling healthy eating [7, 8, 32], and by providing access to healthy food in the home [6, 9].

Moreover, mothers might have a greater impact than fathers on developing children's dietary habits due to the greater amount of time they often spend with their children and their roles in preparing food and grocery shopping. Data from the American Time Use Survey in 2017, found that on an average day in households with children under the age of 6, women spend approximately 1.1 hours providing physical care for their children, such as feeding and bathing, whereas men spend approximately 26 minutes [11]. Furthermore, on an average day, 45% of men spend time doing food preparation and clean up vs. 70% of women [11]. Additionally, a cross-sectional study by Woodruff and Kirby, found that nearly 90% of food planning and food preparation in the household was done by the mothers [33]. Unfortunately, in the US, FV are not amongst some of the most popular foods being prepared and served for these meals.

Lack of FV Consumption

For a 2,000-calorie diet, the Dietary Guidelines for Americans of 2015 recommend 2.5 cups of vegetables and 2 cups of fruit daily. For children, the recommendations are 1 to 2.5 cups of vegetables and 1 to 2 cups of fruit. Additionally, the guidelines advise that individuals should vary the type of vegetables they consume and focus on dark green, red, and orange vegetables, beans, and peas. Each of these vegetables provide different vital nutrients for overall health [28]. Nearly 80% of the population is not meeting the FV recommendations. On average, FV consumption for 19 to 30-year-olds is about 1.6 cups of vegetables and 0.9 cup of fruit. Children 2 to 5 years are consuming approximately 1 cup of fruit and 0.5 cup of vegetables daily [28].

Therefore, it is evident that there is a need for an efficacious nutrition intervention to increase FV consumption among adults and children in the US.

Lack of Physical Activity

Children's trends for physical activity are not much better than their current dietary behaviors. Findings for children ages 0 to 5 who are meeting the National Association for Sport and Physical Education (NASPE) guidelines show that most children are not meeting these guidelines. In a systematic review, out of the 39 included investigations, 46% concluded that preschoolers were meeting the 60 minute NASPE guidelines [34]. Authors explained that PA in many of the studies was assessed using a very conservative guideline (considering only 60 min of either structured or unstructured PA). However, preschoolers should engage in both structured and unstructured PA for a total of 120 min or more a day. Therefore, when considering investigations that included two or more hours for structured and unstructured PA per day, the percentage of articles concluding that preschoolers met the NASPE guidelines dropped from 46% to 23% [34].

Consequences of Obesity

Individuals who are obese are at an increased risk for mortality. A body mass index (BMI) above or equal to 30 increases the risk for chronic health issues such as diabetes [35], coronary heart disease [36], heart failure [37], osteoarthritis [38], sleep apnea [39], and certain types of cancer (endometrial, breast, ovarian, prostate, liver, gallbladder, kidney, and colon)[15, 40]. In addition, research has linked obesity to pregnancy complications [41, 42], stress, incontinence [43, 44], and psychological disorders [45, 46].

Obesity in childhood is also associated with serious health consequences such as increasing the risk for developing high blood pressure, increased cholesterol levels [47],

impaired glucose tolerance, insulin resistance, type 2 diabetes [48], asthma [49], sleep apnea [50], joint problems, musculoskeletal discomfort [51], fatty liver disease [52], gallstones, and gastro-esophageal reflux disease [5]. Moreover, childhood obesity is related to psychological problems such as anxiety, depression, low self-esteem, and social problems such as teasing and stigma [53-55]. As mentioned in the first section of this review, the prevalence of obesity in children 2 to 5 years is 8.9%. This prevalence appears to steadily rise as children age (17.5% for 6 to 11 years and 20.5% for 12 to 19 years) [17]. Thus, interventions that target children in the early years could help prevent obesity and decrease these statistics as children age.

The Importance of Fruit and Vegetable Consumption

According to the Dietary Guidelines of 2015, FV contribute to vital daily nutrient needs such as dietary fiber, vitamin A, vitamin C, vitamin K, vitamin E, vitamin B6, folate, thiamin, niacin, choline, potassium, copper, magnesium, iron, and manganese [28]. The scientific literature has also associated FV consumption with the prevention of chronic illnesses. Diets that are high in FV are associated with a multitude of health benefits such as a reducing the risk of obesity [56, 57], cardiovascular disease [58-60], strokes [60, 61], diabetes [62-64] and certain cancers [58, 60].

In a meta-analysis, findings showed that the risk of all-cause mortality decreased by 5% for each additional serving of FV eaten daily [65]. Another meta-analysis found that there was an 8 to 16% reduction in the risk for coronary heart disease (CHD), a 13 to 18% reduction for the risk of strokes, a 8 to 13% reduction in risk for cardiovascular disease (CVD), a 3 to 4% reduction in the risk for total cancer, and a 10 to 15% reduction risk for all-cause mortality for each 200g/day (~1 cup) increment intake of FV [58]. Additionally, a 20-year longitudinal study of healthy adults, found that those who regularly consumed four or more servings of FV had a

lower prevalence of CHD compared to their low FV consuming counterparts [66]. Likewise, consuming FV instead of energy dense foods may assist in healthy weight management and thereby decrease the risk of developing obesity-related comorbidities [67].

What Impacts Fruit and Vegetable Consumption?

FV consumption is impacted by a variety of different individual factors that include, but are not limited to nutritional knowledge, particularly of FV guidelines, as well as cooking efficacy/skills. An investigation by Krebs-Smith et al., conducted a telephone survey examining the relationship between psychological factors and FV consumption. In this study researchers observed that knowledge of the dietary guidelines for FV was associated with an increased number of servings of FV among a group of adults [68]. Furthermore, nutrition knowledge and diet-disease relationship knowledge were predictive of dietary behavior, especially for FV consumption in a population of adults [69]. However, for those with a lower education, knowledge was not directly linked to dietary behaviors, potentially due to lack of resources or knowledge/skills for food preparation [69].

Moreover, knowledge of the "5 A Day" message for FV recommendations has also been associated with higher FV consumption in a random national sample of adults. Findings from this investigation revealed that self-efficacy regarding eating FV was one of the most consistent and strongly associated variables for FV intake in this population [70]. In addition, poor nutrition knowledge, specifically details of the 5-a-day message, has been related to low FV intake in a group of adults. Respondents who had the least knowledge of details about what makes up a FV portion size as well as the need for variety had the lowest consumption of FV [71].

Another study looking at the factors that impact FV consumption found that FV intake in women tended to be higher among those who had higher levels of education, were older, (for

vegetables only) were married, had greater health considerations, (for vegetables only) had higher nutrition knowledge, and had a family member to support their healthy eating [72]. Moreover, there appears to be varying factors that affect FV consumption in mothers from Generation X (those born 1965-1979) vs. mothers from Generation Y (those born 1980-1990) [73]. Findings from the State of the Plate 2010 showed that moms in Generation X feel more confident than Generation Y moms in their ability to serve fruits and vegetables to their families [73]. Furthermore, Generation Y moms feel like FV are expensive vs. Generation X moms who feel like FV are sensibly priced [73]. Thus, it is evident that different generations have different factors affecting FV consumption. Consequently, interventions aiming to increase maternal FV need to be tailored to different generations.

Another important factor known to impact mothers FV intake is their level of physical activity [73]. The more physically active a mother is the more likely she is to perceive FV to be important and to consume more servings of FV. Findings from the State of the Plate 2010 revealed that Generation Y moms were less likely to feel that FV consumption was important or want to include a greater variety of FV for their meals than Generation X moms. The main barrier observed for both Generation X and Generation Y moms was different family preferences, the need for new preparation ideas, and the lack of FV options in restaurants. Additionally, nearly half of the moms surveyed reported that they would like help with their grocery shopping or an online menu that includes a shopping list [73].

When it comes to children, the lack of FV consumption is usually attributed to a lack of exposure, availability, and accessibility of FV. A qualitative review of the literature found that children preferred unhealthy foods like candy, because of ease of access [74]. Therefore, it is likely that if parents make healthy foods, like FV, accessible and readily available as snacks

between meals they can increase their children's FV intake while simultaneously decreasing the consumption of nutrient poor foods. Furthermore, previous studies have shown that one of the strongest predictors of children's FV consumption is parental intake of FV [75]. Therefore, parents can also help improve their children's diet by modeling the consumption of FV [7, 8, 32] and providing access to healthy foods [6, 9, 10].

In addition, the infrequency of FV consumption in infants 4 to 8 months (< 1 serving of FV daily) is associated with infrequent FV consumption at 6 years of age (< 1 serving of FV daily) [76]. In a longitudinal study of mother/child dyads, investigators observed that the frequency of FV intake in 2-year-olds was significantly associated with FV consumption when these children were one year old. Furthermore, FV intake for these children when they were a year old was linked with availability of FV in the home at the time [77]. In a separate longitudinal study investigators observed that for children 6 to 8 years, FV consumption was associated with FV exposure/variety within the first 2 years of life [78]. Additionally, Haire-Joshu et al., found that parental increased intake of FV resulted in increased FV consumption among preschool children [79]. Thus, it is evident that there are a number of factors that influence FV consumption in children and adults. According to the literature, some of the most impactful factors include cooking confidence, cooking skills, and nutrition knowledge.

Cooking and Fruit and Vegetable Consumption

Evidence shows that cooking skills have been associated with greater FV consumption. Larson et al., found that those who reported frequent food preparation were more likely to meet the dietary guideline recommendations for vegetable intake [80]. In a separate study, authors found that cooking skills correlated positively with weekly vegetable consumption in an adult population [81]. In addition, a recent pilot study found that cooking skills were associated with

higher vegetable intake and food preparation frequency in a population of college-aged adults [82]. For mothers, evidence shows that one of the greatest determining factors keeping mothers from meeting their daily FV recommendations was the lack of knowledge on how to prepare FV [83]. Therefore, it appears that improving individuals' skills and efficacy to cook FV is vital to increase FV consumption.

When it comes to children and cooking, previous studies have found that children are more willing to try new foods if they are part of the food preparation process [84]. In a quasi-experimental study, investigators observed the desirability of five vegetables used in a class recipe before and after the children participated in the recipe preparation. Findings showed that the children in the intervention group significantly increased their preference for the vegetables used in the class recipe [85]. In a separate school-cooking intervention with 5th grade children, researchers measured FV intake and willingness to try FV in children both before and after 11 cooking sessions. Study findings revealed that although the children did not significantly change their dietary habits, their willingness to try new foods increased significantly [86]. Moreover, a review of qualitative literature found that some of the strongest determinants for FV consumption in young children are taste, flavor, texture, familiarity, aesthetics, and smell [74]. Positively, many of these factors can be modified through different cooking preparation methods so that children will find FV more palatable. The literature supports the importance of including children in the food preparation process to increase their willingness to try FV.

Nutrition Knowledge and Fruit and Vegetable Consumption

As mentioned previously in this review, nutrition knowledge is an important factor for dietary behavior. A cross-sectional study using the General Nutrition Knowledge Survey found that the relationship between nutrition knowledge and diet quality was significant in army men

[87]. Additionally, an investigation by Wardle et al. observed that nutrition knowledge was significantly associated with a healthy diet and increased FV intake in a group of 18 to 75 year olds. Those who were most knowledgeable about nutrition were 25 times more likely to consume the recommended amounts of FV daily than their less knowledgeable counterparts [88]. Furthermore, a review of the literature analyzing general nutrition knowledge and adult dietary behaviors found that out of the 29 articles included, 65% of them found a significant relationship between nutrition knowledge and a healthy diet, most often including a higher intake of FV [89].

A six-month randomized controlled trial (RCT) that involved socioeconomically disadvantaged women that were the primary household shoppers found that the intervention successfully increased vegetable consumption by 0.5 servings per day and this increase remained six months post intervention [90]. The main goals of this investigation was to increase FV consumption by increasing knowledge, skills, and self-efficacy in terms of nutrition, cooking, and grocery shopping on a budget [90]. In an observational study, investigators detected that maternal nutrition knowledge was significantly associated with child diet (including FV intake) and home food availability of FV [91]. Findings from these studies make it evident that nutrition knowledge and cooking skills are important factors for FV intake. However, the main problem that studies have faced in improving these factors, especially in parents, is the lack of participant adherence. Conversely, mobile technology is a promising way for delivering behavior interventions due to the ubiquity of mobile phone use in the US, convenience, and accessibility of usage. This in turn, has the potential to increase participant adherence.

Mobile/Online Technology Interventions: Use of Online Technology for Nutrition Education

Many face-to-face interventions have had low participant adherence and retention [12]. This could be due to the inconvenience of face-to-face sessions and the time-demanding schedules of many working adults, specifically parents [92]. Furthermore, face-to-face sessions often cannot be sustained in a larger population, particularly due to the high cost [93, 94]. Mobile technology provides a cost-effective way to reach program participants since most people carry their phones with them everywhere they go. This provides many touch points for reaching individuals at any time and place [95]. The use of mobile technology in the US is vast and evident. The Pew Research Center states that as of January 2018, 77% of Americans owned a smartphone and these statistics continue to rise[13]. Therefore, mobile technology has the potential to increase participant adherence due to its convenience and accessibility [14].

There are a limited number of studies that have used electronic health or mobile health interventions, many of which have resulted in clinically meaningful behavior modifications and weight loss [96, 97]. In a systematic review, authors found that internet interventions were an effective way to improve diet, physical activity, and adiposity [98]. Furthermore, a separate systematic review analyzing mobile telephone text messaging and behavior modifications, found that 92% of the included articles had a positive behavior change; however, many studies were underpowered and thus statistical significance could not be identified [99]. In a study including Latina undergraduate students, findings suggest that a mobile technology intervention (including a photo-sharing app and a website) was a feasible way of delivering healthy eating interventions [100]. However, adherence tended to decline after the second week in this three-week intervention.

Additionally, a qualitative technology intervention including nutrition information, feedback, goal setting, and self-monitoring proved to be a feasible way to improve PA and nutrition behaviors in a group of adult men [101]. Mobile technology interventions have also been done with parents of Pre-K students. A pilot study by Militello et al. aimed to determine the feasibility and effects of a cognitive-behavioral intervention with tailored text messages on the lifestyle behaviors of parents who had overweight or obese Pre-K children [102]. Results showed that the program proved to be a feasible and acceptable way to increase parental nutrition knowledge, PA in children, and beliefs about living a healthy lifestyle [102]. A recent qualitative study done at the University of Georgia examining the perception of nutrition educators on the feasibility of an eLearning nutrition education program found that motivation to engage in the intervention is the primary barrier to program feasibility. Further, authors found that including visual and skills-based education methods (i.e. cooking demonstration videos and recipes) was of importance in an eLearning program [103]. Moreover, in a mixed-methods case study, authors were able to identify that due to the nature of mobile phone usage (brief, quick, and direct), it is vital to create eLearning programs that follow this type of format [104].

In regards to FV, previous mobile technology interventions that aimed to increase daily intake of FV have been successful [105]. A two-week RCT found that a text-messaging intervention that promoted FV consumption was effective at increasing the daily number of servings of FV [106]. Furthermore, a six-month RCT found that using a mobile food record and providing tailored feedback via text is a "promising" way to increase FV intake in young adults [107] Findings from this study also showed that women in both intervention groups (the dietary feedback group and the dietary feedback and text group) increased their daily vegetable servings significantly. Authors also noted that retention was higher in the dietary feedback and text

messaging group (95%) compared to all other groups [107]. Additionally, a meta-analysis found that both eHealth and mHealth interventions are associated with increased FV intake in young adults [108]. Lastly, a twelve-week RCT showed that a mobile application can significantly increase FV intake in an overweight/obese adult population. Participants in this intervention utilized an application called "Vegethon," which allowed participants to set FV goals, self-monitor their FV intake, get feedback about their FV consumption, and compare their results with other participants [109]. However, participants from this investigation were also simultaneously participating in a larger "parent trial." In the parent trial these participants were either in a low-fat or a low-carb diet for 12 months and were encouraged to eat FV. Therefore, this larger study could have affected the results of the Vegathon app study. From these investigations, it appears that technology interventions are an effective and feasible way to modify health behaviors in today's society, especially when considering the demanding schedules of many working adults, especially parents. This investigation aimed to improve the fruit and vegetable consumption of mothers of young children, a group who is usually pressed for time. Thus, usage of a mobile-technology intervention has the potential to be a convenient and accessible way to reach mothers of young children and assist them in increasing their FV consumption.

Rationale

Parents can impact their child's FV consumption via their nutrition knowledge, parental modeling [7, 8, 32], and the foods they provide access to [6, 9, 10]. Often mothers have a greater impact than fathers on developing children's dietary habits due to the greater amount of time they spend with their children [11]. In the US 8.9% of children 2 to 5 years are obese [17].

Childhood obesity has been attributed to serious health consequences such as high blood pressure [47], impaired glucose tolerance, and insulin resistance [48].

Previous research studies frequently encounter low parental retention and adherence to their nutrition interventions [12]. This is likely due to the demanding schedule of many working adults. The use of mobile technology in the US is vast and evident [13]. Due it its ease of access, low cost, and convenience mobile technology has the potential to increase parental adherence [12, 14, 110].

This thesis project is significant because it helped to identify if an online intervention was a feasible and acceptable way to increase nutrition knowledge and self-efficacy for cooking skills among mothers of young children. This study also helped fill gaps in the literature about the relationship between increased general nutrition knowledge, self-efficacy for cooking and FV consumption in mothers. This research team was well-qualified to carry out the proposed research because of our combined expertise in child development (Bales), child nutrition (Cotwright), and mobile technology interventions (Lee).

Specific Aims and Hypotheses

The overall hypotheses of this study were:

1) Mobile technology is a feasible and acceptable way to increase nutrition knowledge and cooking confidence among mothers of young children; and
2) Increasing nutrition knowledge and cooking confidence will result in an increased daily number of servings of fruits and vegetables that mothers of young children consume.

The specific aims of this study were to:

1) Determine the effect of increasing nutrition knowledge on the daily number of servings of fruits and vegetables among mothers of young children. *It is hypothesized that increased nutrition knowledge will be associated with increased number of servings of fruits and vegetables eaten daily.*
2) Determine the effect of increasing cooking confidence on daily number of servings of fruits and vegetables among mothers of young children. *It is hypothesized that*

increasing self-efficacy and improving cooking skills will be associated with an increased number of servings of fruits and vegetables eaten daily.

3) Determine the feasibility and acceptability of using mobile technology to increase nutrition knowledge, self-efficacy, and cooking skills among mothers of young children. *It is hypothesized that mobile technology will be a feasible and acceptable way to increase nutrition knowledge, self-efficacy, and cooking skills among mothers of young children.*

CHAPTER 3

THEORETICAL FRAMEWORK, CURRICULUM DEVELOPMENT TAXONOMY, AND METHODOLOGY

Theoretical Framework: SCT

The theoretical framework for this pilot study is Bandura's Social Cognitive Theory (SCT). SCT is grounded in the belief that individuals learn in a social context with a dynamic interaction between the individual, the environment, and their behavior [111]. Thus, a child's dietary behavior (including FV intake), is influenced by environmental and personal factors, and the behavior itself (FV intake) influences these same factors. Parents are a major component of a child's social environment (especially during early childhood) and are thereby agents for change [7]. According to observational learning, (a construct of SCT) individuals can learn and model another person's behavior [111]. Therefore, children can observe and learn the behaviors they see their parents modeling. Thus, parents influence children's food preferences and eating habits [112, 113].

SCT has been found to be a successful theoretical framework for intervention in a variety of populations. A computer based intervention that used SCT was successful at increasing and maintaining FV consumption 4 to 6 months' post-intervention in a random sample of super-market food shoppers [114]. In a health promotion study researchers observed that several constructs of SCT, including social support, self-efficacy, and outcome expectations impacted individual's nutrition behavior in an adult population [115]. Moreover, evidence shows that social support or the support from important persons in our surroundings such as family and

friends, has been associated with positive dietary modifications in adults [116, 117]. Further, investigators have found that nutrition interventions based on SCT have been successful at increasing maternal nutrition knowledge and improving maternal efficacy for providing a healthy home food environment [118]. Finally, a recent mobile study basing its intervention on SCT (with an emphasis on the four conditions necessary for observational learning to occur: attention, retention, reproduction, and motivation) found that in a population of overweight adults, daily vegetable consumption was significantly greater in the intervention vs. the control group [109].

Another major component of SCT is self-efficacy. Self-efficacy is the level of confidence a person has in their ability to successfully perform a behavior [111]. Self-efficacy is considered to be one of the most important components of SCT that translate into behavior modification [119]. In a study of 109 parents of sixth grade students, researchers observed that self-efficacy was one of the main factors impacting how parents encouraged FV intake and child FV consumption [120]. Furthermore, evidence shows that maternal self-efficacy is correlated with children's diet and sedentary behaviors [121]. In addition, a study looking to increase maternal intake of FV by increasing self-efficacy for eating FV, found that the intervention was successful at both increasing self-efficacy for eating FV and daily servings of FV in both women and their children [122].

Lastly, self-regulation has been proven to be successful in nutrition interventions. Engaging in self-regulatory behaviors, such as goal setting, has been associated with improved dietary habits such as increased FV consumption [123]. Using a theoretical framework such as SCT, is essential to appropriately understand overweight and obese behaviors and to create efficacious interventions [124].

Curriculum Development: Fink's Taxonomy

The curriculum for the intervention was based on Fink's Taxonomy of Significant Learning. Fink identifies significant learning as a lasting change in students. According to this taxonomy, there are six different ways significant learning can occur. These include: learning how to learn, foundational knowledge, application, integration, human dimension, and caring (see Figure 1). All six of these components interact with each other. Fink identifies that "achieving any one kind of learning simultaneously enhances the possibility of other kinds of learning being achieved" [125].

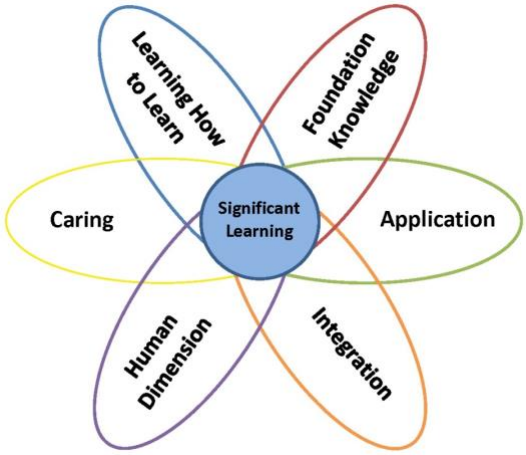

Figure 1. Fink's Taxonomy

Foundational knowledge refers to the ability for students to understand and remember information. This type of learning proves a basic understanding that is needed for other kinds of significant learning to occur. Application involves learning how to engage in a specific action, such as developing a skill. This type of learning allows for other types of learning to be more useful. Integration is the type of learning that occurs when students can understand the connection between different ideas, people, etc. Human dimension is when students are able to understand or integrate the information learned to themselves or others. This might result in changing of self-image or self-ideal or even understanding the behaviors of others. The

component of caring refers to developing feelings, interest, or values to the information being learned. This type of learning is important because it motivates students to learn the information and make it a part of their daily lives. Finally, the component of learning how to learn, involves teaching the students how to learn so that they can continue to learn even after the intervention is over [125].

Study Design

This feasibility study utilized a pretest-posttest design. The pretest was conducted one week before the intervention, the intervention was six weeks in duration, and the posttest was completed one week after the intervention.

IRB approval

All methods were approved by the University of Georgia Institutional Review Board before any procedures with human subjects were initiated.

Study Sample and Recruitment

The research team recruited female participants between the ages of 18 to 45 years. The inclusion criteria was that participants must have: 1) a child between the ages of 0 to 5 years; 2) a smartphone with active data and text messaging services; and 3) live in the Northeast Georgia region. Mothers were excluded if they had been in a weight loss program or had made significant changes to their diets within the last six months. Recruitment methods included posting flyers (see Appendix A) at 15 different childcare centers, two elementary schools, one prenatal center, one WIC clinic, one health department, and two churches. Additionally, mini versions of the flyers and mini granola and fruit Mason jars were distributed face-to-face at different maternal group events (events were either held at reBlossom or Athens Mothers Center) in aims to pique maternal interest in the study. Moreover, we posted Facebook Advertisements (same as flyer)

three to four weeks before the study commencement. Study flyers were also posted and shared on Facebook pages where mothers were likely to view them (such as Facebook pages that were mother's groups in Athens Georgia). Participants interested in the study were directed to take an online survey that tested for their eligibility (see Appendix B). During this survey participants were asked basic demographic information.

Salubrious Seed Curriculum Development

Salubrious Seed was chosen as the title of the curriculum because it emphasizes a growing understanding of health and a growing adoption of healthy eating habits. As mentioned previously, the intervention curriculum was based on Fink's Taxonomy (see Figure 1) and Social Cognitive Theory (SCT). From the SCT theory, there was a focus on the components of behavior change, observational modeling, positive reinforcements, self-efficacy, and expectations (see Table 1).

Table 1. Fink's Taxonomy and SCT Components for The Curriculum

Foundational Knowledge		
Week	**Objective**	**Social Cognitive Theory Construct**
Foundational Knowledge		
1	Remember basic food and nutrition knowledge	Behavioral capability by providing the knowledge to make healthy decisions
1	Remember health benefits that FV provide	Behavioral capability by providing the knowledge to identify the importance of why people need FV
2	Identify self and child's daily FV needs	Behavioral capability by providing the knowledge to identify how many FV are needed
2	Understand FV serving sizes in terms of 1-cup equivalent	Behavioral capability by providing the knowledge to identify exactly what a serving (portion) of FV is

		Self-efficacy because by giving a person the knowledge to identify serving sizes they can be more confident in making the decision to eat more FV
2	List ways to increase daily FV consumption throughout the day	Behavioral capability by providing the knowledge to identify meals where they can incorporate FV Self-efficacy by giving a person the knowledge to identify ways to increase their FV makes it easier to actually engage in this behavior
3	Identify at least 2 FV that are in season	Behavioral capability by providing the knowledge to identify FV that will be at the best cost and quality
3	Remember ways to properly and safely store FV	Behavioral capability by providing the knowledge to identify where is the best location to store FV to keep them food safe and at their best quality for the maximum amount of time
4	Identify the steps needed to plan for food shopping	Behavioral capability by providing the knowledge to identify the steps needed to plan a successful weekly menu
5	Remember basic cooking terminology	Behavioral capability by providing the knowledge to identify commonly used cooking terminology found in recipes Self-efficacy by giving the person the knowledge to understand cooking terminology can increase their confidence to cook because they can now understand the recipe

5	Identify basic cooking tools	Behavioral capability by providing the knowledge to identify commonly used cooking tools found in recipes Self-efficacy by giving the person the knowledge to identify cooking tools they need can increase their confidence to cook because they can understand the recipe better
6	Identify ways to include children in the food preparation process	Behavioral capability by providing the knowledge to include children during cooking
Application		
4	Be able to create a weekly menu that meets their families daily FV needs	Behavioral capability by providing the skill of creating a weekly menu Self-efficacy because they will be able to see that they are capable of creating a weekly menu
4	Be able to create a grocery list from the menu	Behavioral capability by providing the skill of creating a grocery list Self-efficacy because they will be able to see that they are capable of creating a grocery list
4	Be able to create a recipe with their children	Self-efficacy by seeing that they can re-create a healthy recipe Positive reinforcements by giving positive internal cues if the behavior results in a successful outcome
Integration		
1	Identify the interaction between eating more FV and health benefits	Expectations that if they eat FV as recommended then they can expect to have a

		lower risk for certain diseases
4	Identify the interaction between planning for food shopping and eating more FV	Expectations that if they plan their meals ahead of time they will be more likely to eat their recommended FV Positive reinforcement through saving money and time by menu planning
6	Identify the interaction between modeling FV consumption and children's own FV intake	Observational learning for their children because children will be observing maternal behaviors and identify those as acceptable
Human Dimension		
2	Come to see themselves as capable of meeting their daily FV needs	Self-efficacy that they can eat recommended FV servings Expectations that by following certain steps they will be able to meet their daily FV needs
5	Come to see themselves as capable of preparing healthy meals	Self-efficacy to cook healthy meals Expectations that if they can read a recipe they can create a healthy meal
Caring		
1	Value the importance of eating the recommended FV for health protective reasons	Reciprocal determinism because their personal factors (self-efficacy for eating healthy) is influencing their behavior (eating recommended FV and cooking healthy) Positive external reinforcement when they see that their children's health also benefits from the healthy decisions they make
6	Be more interested in making	Expectations that if they

	healthy lifestyle choices for themselves and for their children	keep making healthy decisions their children are more likely to identify this behavior as the norm
Learning How to Learn		
6	Identify important source of information where they can find more healthy recipes and nutrition tips	Behavior capability from their previous knowledge to find online resources that have healthy recipes and useful tips for leading a healthy lifestyle

Intervention

The Salubrious Seed Intervention was implemented between October to December 2017. Recruitment occurred in September and the curriculum was implemented for a period of six weeks. The intervention had two main components: 1) a direct component; and 2) an online component. The goal of the intervention was to increase mothers' daily FV intake by increasing nutrition knowledge and self-efficacy for cooking skills.

The direct component:

Participants met face-to-face at baseline to kick off the intervention. The session commenced with a food demonstration of a Slow Cooker Spinach Soup. During this meeting consent forms and study protocol were explained. Additionally, information was provided on adult and childhood obesity, the consequences of obesity, benefits of FV consumption, and how mothers impact the dietary decisions of their children. After this meeting, participants received an email with a mobile friendly and downloadable cookbook (pdf format). For those mothers who were unable to attend the face-to-face session, they received a video of the kick-off presentation. Within this video, information was explained exactly the same as at the kick off session. To ensure the exact information was provided for the face-to-face session and the video presentation, a script for the presentation was created.

The online component:

New lessons and activities were uploaded weekly on a Facebook page and blog (see Table 2). At the end of each week, a FV was highlighted that was in season for the fall. Furthermore, nutrition information, season of harvest, buying, storing, and cooking information was provided on the FVs of the week. In addition, with the FV highlight, a cooking demonstration and additional instructional videos were provided. The instructional videos focused on cooking skills performed during the cooking demonstration. For example, when bananas and beets were highlighted during week two, a cooking demonstration for a healthy banana muffin recipe was uploaded. Along with the food demonstration, an additional video displaying exactly how to mash the bananas (a skill required for the recipe) was also uploaded. The recipes in the cooking demos were designed to be palatable for the whole family. Most of the lessons included information on behavior modification, nutrition knowledge, and meal preparation.

The main purpose of the Facebook page was to provide a place for the participants to engage with each other. The Facebook page and blog were monitored daily by a researcher. Additionally, the researcher made bi-weekly post to help participants feel motivated. The main purpose of the blog was to provide the in-depth information about the lessons. Each blog took approximately 5 to10 minutes to read. For the longer blogs participants were encouraged to skip around and read mainly what they found to be most helpful. The blogs were designed to increase foundational nutrition and cooking knowledge specific to FV. Feedback was provided weekly to the participants based on compliance with their goals as well as any additional needs or request. Feedback encouraged mothers to meet their FV goals and their home-cooked meal goal. Additional resources were provided if a participant was struggling to

meet their goals. For example, when a participant stated that they would like to have more meal ideas for a specific FV they love, the researchers would follow-up with more links to healthy recipes including the FV requested.

Table 2. Salubrious Seed Curriculum: Key Concepts and Activities

Week	Key Concepts	Activities
1: Introducing Nutrition	Basic Nutrition Knowledge Common nutrients found in the 5 food groups FV health benefits	Blog: How to make healthy changes? SMART goals Blog: What is MyPlate? Blog: Reading a nutrition label Blog: Highlighting broccoli and cranberries Facebook (FB) Activity: MyPlate quiz
2: FV Needs	Daily FV needs FV serving sizes	Blog: What are your FV needs? Blog: Tips on how to increase FV throughout the day Blog: Highlighting beets and bananas FB Activity: Share with peers ways that they successfully integrated more FV to their day
3: Season of Harvest	Purchasing FV Storing FV	Blog: Season of Harvest Blog: Food Safety Tips Blog: Highlighting sweet potatoes and grapes FB Activity: Grocery store scavenger hunt
4: Menu Planning	Purchasing FV	Blog: How to plan a weekly menu Blog: How to create a grocery list from the menu Blog: Highlighting cauliflower and raspberries FB Activity: Trying out the 7 steps of menu planning
5: Basics to Cooking	Preparing FV	Blog: Basics to cooking Blog: Basic knife skills and terminology Blog: Highlighting spinach and pears

		FB Activity: Cooking terminology quiz FB Activity: Encouraged mothers to share recipes they cooked for the week
6: Including Children	Preparing FV Modeling FV consumption	Blog: Including children during cooking FB Activity: Encourage family discussions about their favorite FV FB Activity: Encouraged mothers to use blog tools to ask children to help them menu plan FB Activity: Encouraged mothers to share their favorite websites from the intervention to find recipes

Self-monitoring

Mothers set daily goals for FV intake and weekly goals for the number of times they wanted to prepare meals at home. FV consumption was monitored three times per week and cooking goals were monitored weekly via text message. To increase motivation to meet goals and complete weekly lessons mothers were awarded $5 towards an Amazon e-gift card if they were meeting their goals. Mothers received their total prize at the end of the intervention (total amount varied by number of weeks that mothers met their goals not to exceed $30).

Measures

A survey was used to assess maternal FV consumption at baseline and post intervention. The survey used was from the "Food Attitudes and Behavior Survey" by the National Cancer Institute [126]. This is a two-item assessment of daily servings of FV (see Appendix C).

Cooking self-efficacy and skills were assessed at baseline and post intervention by using the "Cooking Attitude and Self-Efficacy Survey" by the California Department of Public Health [127]. This survey uses a 5 point Likert scale to identify different cooking skills and the

confidence to perform that specific skill (see Appendix D). Scores can range from 19-95; the lower the score the less self-efficacy and individual has for cooking.

Mother's nutrition knowledge was assessed at baseline and post-intervention by using a modified version of the General Nutrition Knowledge Questionnaire for Adults [128]. In the first section of the survey participants identified the appropriate food sources of specific nutrients. In the second section of the survey participants identified diet-disease relationships of specific nutrients (see Appendix E). Scores could range from 0-47; the lower the score the less knowledgeable an individual was about nutrition.

To assess participant's perception of the feasibility and acceptability of the weekly lessons mothers responded to an 11-question survey on Qualtrics, a web based survey platform. The survey asked participants to identify the strengths and weaknesses of each lesson (see Appendix F). Furthermore, to assess overall perception of the program at post intervention, a 12-question survey was sent out to participants to assess overall strengths and weaknesses of the mobile technology intervention (see Appendix G). In addition, to assess adherence and to motivate participants to meet their weekly goals, researchers checked in with study subjects three times per week on Mondays, Wednesdays, and Fridays. During each of these check-ins participants were asked about their daily FV consumption. Once per week on Mondays, the investigator also checked-in for compliance of the home cooked goal. Therefore, interaction between the researcher and each of the participants was done for a maximum of 18 times throughout the six-week intervention.

Statistical Analysis

Wilcoxon Signed Rank tests were conducted to compare changes in mothers' nutrition knowledge, cooking skills, self-efficacy, and food attitudes and behaviors before and after the

intervention, with $P < .05$ considered significant. The nonparametric tests were selected in place of a paired t-test because certain variables in each of the measures were not normally distributed. We analyzed all data using SPSS version 24.0. For the General Nutrition Knowledge Questionnaire for Adults, a scoring system was utilized to determine the maximum amount of points an individual could score per question. Points available per question varied from question to question; the maximum score available was 47, the higher the score the greater the general nutrition knowledge.

To analyze the Cooking Attitudes and Behavior Survey**,** a coding system was used to determine cooking confidence. Answer choices were assigned an individual code that represented the extent to which the participants felt confident about performing specific cooking activities along the Likert scale. The codes assigned to each choice were as follows: not at all confident = 1, not very confident = 2, neutral =3, confident = 4, and extremely confident = 5. The highest possible points attainable were 95 and the least points were 19, the higher the score the greater the confidence for cooking.

To assess the difference between pre and post FV intake an average for each option was calculated since the answer choices were provided in ranges. The following averages were given for the corresponding ranges: None = 0 cups, ½ cups or less = 0.5 cups, ½ - 1cup = 0.75 cups, 1-2 cups = 1.5 cups, 2-3 cups = 2.5 cups, 3-4 cups = 3.5 cups, 4 cups or more = 4.5 cups. Wilcoxon Signed Ranks Test were completed to calculate the pre and post test scores of fruit individually, vegetables individually, and then FV combined.

To assess if there was a relationship between changes nutrition knowledge and FV consumption and between changes cooking confidence and FV consumption separate chi square

analyses were administered between each of these 2 variables. Nutrition knowledge scores were categorized as improvement or no improvement, cooking confidence scores were categorized as either increased or decreased, and FV scores were categorized as increased or no increase.

The Feasibility and Acceptability Surveys were analyzed to determine participant's perceptions of the feasibility and acceptability of the salubrious seed intervention. To assess how participants perceived the intervention percentages were calculated to identify the total number of participants who identified that the weekly or overall curriculum had increased their knowledge about healthy foods, cooking skills, and confidence to cook healthy foods. Moreover, to assess feasibility of the study a number of different variables were analyzed. First, to assess weekly adherence to the intervention weekly blog views, responses to text-messages, and responses to the feasibility and acceptability survey were assessed. Weekly blog views were calculated by taking the average number of views for all the blogs posted throughout the week. Weekly text-message response rate was calculated by identifying the percent of individuals who responded at least once throughout the week. Feasibility survey response rate was calculated by identifying the percentage of individuals that took the Feasibility and Acceptability Survey for that week.

Second, to assess the feasibility of the overall intervention chi square analyses were done to identify if the text-message response rate was associated with the participant's nutrition knowledge scores, cooking confidence scores, or FV consumption. For this analysis, in order to assess these relationships, text-message response rates were categorized as follows: none responders (0 text-responded), low response rate, (< 10 text responded), and high response rate (≥ 10 text responded). Nutrition knowledge scores were categorized as either improvement or no

improvement, cooking confidence scores were categorized as either increased or decreased, and FV intake was categorized as either increase or no increase.

Finally, to further assess the feasibility of the overall intervention chi square analyses were done to address the relationship between a perceived increase in nutrition knowledge and cooking confidence (from the overall Feasibility and Acceptability survey) and the actual nutrition knowledge and cooking confidence scores (from the General Nutrition Knowledge Questionnaire and the Cooking Attitudes and Behavior Survey).

CHAPTER 4

RESULTS

Salubrious Seed Participant Demographics

The sample included women who had a child between the ages of 0-5 years, a smartphone with active data and text messaging services, and who lived in the Northeast Georgia region. Ninety-two percent of the participants were non-Hispanic white, 4% were Asian, and 4% were Hispanic. Ages of the participants were 21 to 29 years (24%), 30 to 39 years (60%), and 40 to 45 years (16%). The highest level of education completed varied as follows: high school/GED (4%), some college, but no degree (12%), Associates (4%), Bachelor's (52%), and some form of a graduate level degree (28%). The combined money earned per household ranged from $10,000 to $24,999 (12%), $25,000 to $49,999 (40%), $50,000 to $74,999 (16%), $75,000 to $99,999 (20%), and $100,000 and above (12%) (see Table 3).

Table 3. Demographics of Mothers Enrolled in Salubrious Seed Study N=25

Characteristic	Category	n (%)
Income Level	**$0-9,999** **$10,000-24,999** **$25,000-49,999** **$50,000-74,999** **$75,000-99,999** **$100,000 and above**	**0 (0%)** **3 (12%)** **10 (40%)** **4 (16%)** **5 (20%)** **3 (12%)**
Race/Ethnicity	**White** **Black** **Asian** **Hispanic**	**23 (92%)** **0 (0%)** **1 (4%)** **1 (4%)**
Age	**21-29** **30-39** **40-45**	**6 (24%)** **15 (60%)** **4 (16%)**

Education	**High School** **Some College, no degree** **Associate's** **Bachelor's** **Graduate**	**(1) 4%** **(3) 12%** **(1) 4%** **(13) 52%** **(7) 28%**

Seventy-two percent (n = 18) of individuals completed all of the post-assessment questionnaires. Of those individuals that did not complete the study (n = 7), 43% of them were between the ages of 40 to 45, 71% had a Bachelor's degree, and 43% of them had a total household income between $25,000 to 49,999, and 100% of them were non-Hispanic white. The only demographic difference between those individuals that completed the intervention and those that did not was that the majority of the participants who remained in the intervention were between the ages of 30 to 39 while those that dropped out were mainly between the ages of 40 to 45 years.

Findings from the General Nutrition Knowledge Questionnaire

Nutrition knowledge was assessed by calculating a score for each individual question from the assessment. Questions on the survey assessed overall general nutrition knowledge; specific topics included foods high in added sugars, high or low in sodium, fat, protein, fiber, healthy meat alternatives, foods with different types of fats, and food and disease relationships (see Appendix E). The maximum amount of points that could be earned from the survey was 47. The Shapiro-Wilk test for normality showed that pre (P =.03) and post (P =.02) scores were not normal. Thus, a nonparametric test was utilized to assess the differences between post and pre nutrition knowledge scores. Overall, 19 participants completed this survey. The Wilcoxon Signed Ranks test revealed that post nutrition knowledge increased significantly from baseline (P =.049 Z =1.66). Survey scores went from a median of 37.00 to a median of 39.00.

Findings from the Cooking Attitudes and Behavior Survey

Cooking confidence and self-efficacy were assessed by a 19 question Likert scale survey. One point was earned when participants selected "not at all confident" and up to five points were earned per question when participants selected "extremely confident." Possible points ranged from 19-95; the higher the score the greater the confidence for cooking skills. The survey assessed cooking confidence for differing skills such as using knife skills, steaming, sautéing, and stir-frying (see Appendix D). The Shapiro-Wilk test for normality showed that the pre and post scores (P = .024) were not normal. Therefore, a non-parametric test was utilized. The Wilcoxon Signed Ranks Test showed that the post scores for cooking skills and efficacy improved significantly (P = .000135; Z = 3.64). Survey scores went from a median of 70.00 to a median of 81.50. Overall, 18 participants completed this survey.

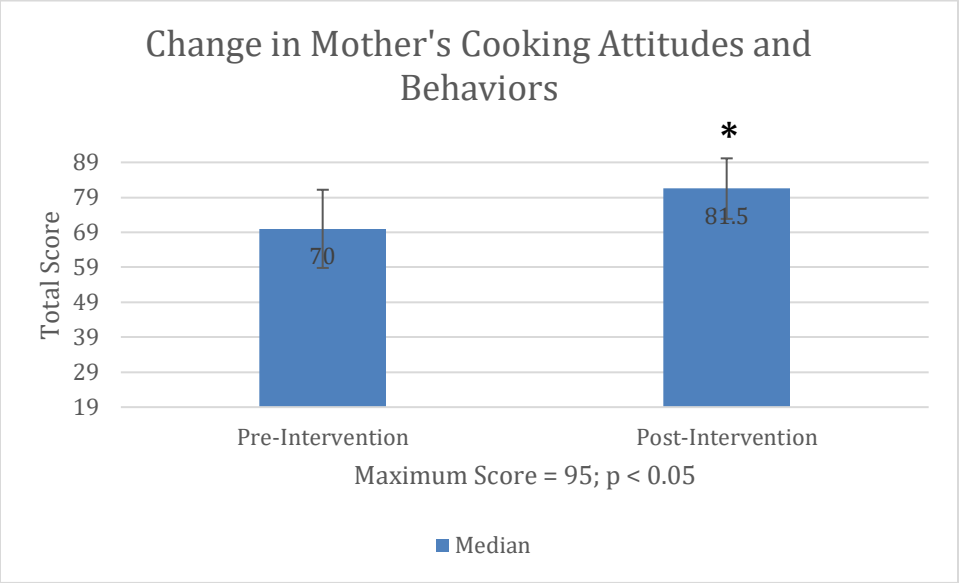

Figure 2. Changes in Mothers' Cooking Attitudes and Behaviors After Participation in the Salubrious Seed Intervention

Findings from the Food Attitudes and Behavior Survey

Fruit and vegetable intake was assessed pre and post intervention by using a two-question survey that assessed number of cups consumed for fruits and vegetables separately. Ranges of fruit intake varied from 0 to 4+ cups and the same format was presented in the vegetable question (see Appendix C). Fruit intake, vegetable intake, and FV intake were assessed individually. Overall 18 participants completed this survey.

The Shapiro-Wilk test revealed that the pre scores for fruit intake were not normal (P = .008). Thus, a nonparametric test had to be used. The Wilcoxon Signed Rank test showed that post fruit intake improved significantly from baseline (P = .002; Z = 2.917). The average fruit consumption went from a median of 1.50 to a median of 2.50, thus fruit intake increased by 1 serving.

Vegetable intake for the pre (P = .013) and post (P = .006) scores did not follow a normal distribution, thus a nonparametric test had to be used. The Wilcoxon Signed Ranks Test revealed that post vegetable intake was significantly greater (P = .0015; Z = 2.92) than before the intervention started. The average vegetable consumption went from a median of 1.50 to a median of 2.50, thus vegetable intake increased by 1 serving.

Finally, normality was assessed for each of the variables for FV intake. The data for post FV intake was not normal (P= .451) thus a nonparametric test was conducted. The Wilcoxon Signed Ranks Test revealed that post FV intake was significantly greater (P = .0005; Z = 3.20) than pre FV intake. Specifically, FV intake went from a median of 3.0 servings of FV to 5.0 servings, thus, FV intake increased by 2.0 servings.

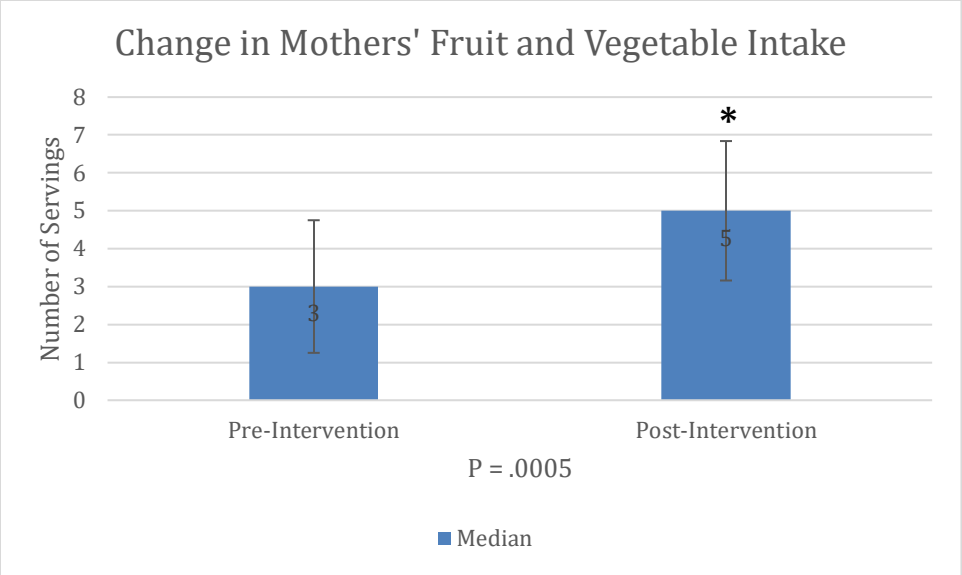

Figure 3. Changes in Mothers' Fruit and Vegetable Intake after Participation in the Salubrious Seed Intervention

Associations between Nutrition Knowledge, Cooking Confidence, and Fruit and Vegetable Intake

To analyze if there was a relationship between changes in nutrition knowledge and FV consumption and between change in cooking confidence and FV consumption separate chi squares analyses were administered between each of these two variables. Nutrition knowledge scores were categorized as either improvement or no improvement, cooking confidence scores were categorized as either increased or decreased, and FV intake was categorized as either increase or no increase. Overall, out of the 18 participants that completed the study 12 of them improved their nutrition knowledge whereas six had no improvement. Further, 17 of them increased their cooking confidence whereas 1 had no improvement. Similarly, 16 of the participants increased their FV intake and one had no increase. The chi square analyses revealed that there was not a significant association between changes in nutrition knowledge and fruit and vegetable consumption (P = .289); however, there was a significant association between increased cooking confidence and fruit and vegetable consumption (P = .004).

Findings from the Feasibility and Acceptability Surveys

At the end of each week (Weeks 1-5) a feasibility and acceptability survey were distributed to participants to assess their perception of the feasibility and acceptability of the weekly curriculum. Week 6 was not assessed to avoid over burdening participants with surveys since the following day they received post measures for general nutrition knowledge, cooking self-efficacy, and the overall feasibility and acceptability survey.

Table 4. Mothers Self-Reported Responses to Weekly Feasibility and Acceptability Questions for the Salubrious Seed Intervention

Intervention Week & Topic	n*	Study Outcome Reported as Improved	% Yes	Participant Feedback
1 Introducing Nutrition	19	Knowledge Cooking Skills Confidence	89 53 69	*"I learned portion sizes on fruits and vegetables. This helped to me to decide what my plates should look like when I was preparing foods."* *"I like the highlight on a specific food (broccoli and cranberries). I learned what to look for when buying fresh which is something that I struggle with knowing if I'm grabbing the best produce."*
2 FV Needs	13	Knowledge Cooking Skills Confidence	85 77 83	*"Learning the measurement for a serving size helped me realize how easy it can be to fit the servings into daily meals."* *"I tried the tip on keeping washed, cut up and portioned fruit on hand for easy snacks for the kids. Also the breakdown of serving size helped me to plan meals for the week and how much of what."*

3 Season of Harvest	7	Knowledge Cooking Skills Confidence	100 71 86	*"The info about food safety and storage had a lot of good information that I didn't know."* *"It made me feel confident that my food wouldn't be contaminated by a dirty fridge."*
4 Menu Planning	9	Knowledge Cooking Skills Confidence	100 100 83	*"I feel more comfortable cutting vegetables more effectively, as well as using different cooking methods, especially of vegetables."*
5 Basics to Cooking	6	Knowledge Cooking Skills Confidence	83 83 100	*"I learned more about pears. A fruit I love but rarely buy."* *"I tend to always use the same knives and I don't cut things in the most efficient way."*
* Survey participation varied greatly from week to week the n for each question was based on response rate and not N=25.				

Table 5. Mothers Self-Reported Responses to the Overall Feasibility and Acceptability Survey Questions for the Salubrious Seed Intervention n=19

Study Outcome Reported as Improved	**% Yes**	**Participant Feedback**
Knowledge Cooking Skills Confidence	84 79 84	*"It both kept me on track (thinking about my goals, desires for healthy food and what actual healthy meals look like.) The lessons were easily accessible, short- to the point and informative."* *"I learned a lot of cooking skills, especially in regards to cutting food. I learned what foods are in season. I learned some new recipes. I learned more about the nutrients in each food. I learned that I feel better the more fruits and veggies I eat!!"* *"I have a better idea of what is actually healthy and why it is and recipes to go along with that knowledge."* *"It was there, it was timely, it was easy to read, there were additional resources to look at."* *"They were easy to understand, easy to follow, and not difficult to implement. I liked the access from Facebook, and the Facebook group in general was great."*

Suggestions for making improvements to the overall blog included: having more interaction with other participants "like a weekly group meeting online or in-person", shorter blog post, and providing a hands-on cooking class. The most consistent suggestion was to make the blogs shorter, due to mother's tremendously busy schedules.

Furthermore, to assess weekly adherence to the intervention weekly blog views, responses to the text-messages, and responses to the feasibility and acceptability survey were assessed. Weekly blog views were calculated by taking an average number of views for all the blogs posted throughout the week. Weekly text-message response rate was calculated by identifying the percent of individuals who responded at least once throughout the week. Feasibility survey response rate was calculated by identifying the percentage of individuals that took the Feasibility and Acceptability Survey for that week. A summary of findings is highlighted in table 6.

Table 6. Weekly Interaction With Salubrious Seed Intervention Components

Week	% Text-Message responders[a] (n)	% Survey Responders (n)	% Blog Views[b] (n)
1	**72% (18)**	**76% (19)**	**32% (8)**
2	**80% (20)**	**52% (13)**	**25% (6.33)**
3	**64% (16)**	**28% (7)**	**32% (8)**
4	**68% (17)**	**36% (9)**	**12% (3)**
5	**68% (17)**	**24% (6)**	**19% (4.66)**

[a:] Responded to text-messages at least one time during the corresponding week
[b:] Average weekly views

To assess the feasibility of the overall intervention chi square analyses were done to identify if the response rate for the weekly text messages had any association with the participant's nutrition knowledge scores, cooking confidence scores, and fruit and vegetable consumption. For this analysis, in order to assess these relationships, text-message response

rates were categorized as follows: none responders (0 text-responded), low response rate, (< 10 text responded), and high response rate (≥ 10 text responded). Out of the 18 participants that completed the intervention 16 of them were high-responders.

Despite the high adherence to the text-messaging component, findings revealed that nutrition knowledge (P = .180) and text-message response rates were not significantly associated (P = .180) nor was cooking confidence and text-message response rates (P = .716). However, those that were high responders 60% of them significantly increased their nutrition knowledge and 93.8% of them significantly increased their cooking confidence. Similarly, response rates were not significantly associated with FV consumption (P = .596). However, of those that were high responders 87.5% of them increased their fruit and vegetable intake. Of note, those participants who did not complete the post-assessment measures were mainly non responders (n = 4) and or low responders (n = 3). Because they did not reply to the post-assessment measures their cases could not be analyzed.

In addition, to measure the overall feasibility of this intervention chi square analyses were done to address the relationship between perceived increase nutrition knowledge and the actual nutrition knowledge score. Chi square analyses revealed that there was no significant association between perceived nutrition knowledge and actual nutrition knowledge scores (P = .180). However, of those who perceived an increase in nutrition knowledge, 73.3% of participants did increase their nutrition knowledge scores. Associations between perceived cooking confidence and the cooking confidence scores also revealed no significant association (P = .716). Nevertheless, of those that perceived an increased cooking confidence 93.8% did improve their cooking confidence scores.

CHAPTER 5

DISCUSSION

We hypothesized that mobile technology would be a feasible and acceptable way to increase nutrition knowledge, self-efficacy, and cooking confidence skills among the mothers of young children. Study findings revealed that this was partially true. First, findings from the overall Feasibility and Acceptability Survey showed that 84% of participants perceived that the six-week curriculum increased their knowledge about healthy foods, 79% reported an increase in their cooking skills and 84% stated an increase in cooking confidence. Therefore, participants perceived the intervention to be a feasible way to improve their nutrition knowledge and cooking confidence skills. These results align with findings in other mobile interventions in the current literature. A literature review analyzing mobile telephone text messaging and behavior modifications found that 92% of the included articles resulted in a positive behavior change [99]. Lastly, a RCT that aimed to test the efficacy of an interactive web-based intervention found that their technology intervention was a feasible way to improve PA and nutrition behavior in a population of adult males [101].

Second, findings from the Cooking Attitudes and Behavior Survey also supported our first hypothesis. Participants significantly increased their cooking confidence scores at post-intervention. This is a finding that also agrees with the previous literature. A study by Surgenor et al., showed that in a group of women, video technology was an acceptable way of teaching low-skilled domestic cooks as well as promoting their confidence and self-efficacy to cook [129].

Third, findings from the General Nutrition Knowledge Questionnaire revealed that participants significantly improved their general knowledge from baseline to post-intervention. This finding is in agreement with the previous literature. One pilot study that utilized a tailored text-messaging intervention for parents with overweight and obese children was successful at significantly improve parental knowledge about nutrition [102].

Fourth, chi square analyses that were completed to assess the feasibility of the overall intervention revealed that there was no significant association between text-message response rate and improved nutrition knowledge, cooking confidence, or FV consumption. This finding is not in agreement with the previous literature as other interventions have found that tailored text-messages resulted in either a large or medium association between parental nutrition knowledge and other health behaviors [102]. The lack of association between these variables could potentially be explained by the fact that we were not able to include in our analyses seven participants that were none responders or low responders to the text-messages because they did not complete the post-assessment measures, therefore if these individuals could have been assessed stronger associations might have been observed.

We also found that there were no significant associations between participants' perceived nutrition knowledge and cooking confidence and their actual nutrition knowledge and cooking confidence scores. There were some participants that perceived that their nutrition knowledge or cooking confidence had not increased when it actually had and vice versa. Few studies have looked at the associations between perceived and actual nutrition knowledge and cooking confidence levels. An older study by Radecki and Jaccard found that there was low correspondence between actual and perceived knowledge [130]. Further, an investigation looking at perceived vs. actual knowledge about prostate cancer among African Americans found that

there was a moderate correlation between actual and perceived knowledge of the disease [131]. Yet, another study found that nurses' actual and perceived knowledge of diabetes mellitus was positively correlated [132]. Thus, it appears that most studies find a relationship between perceived knowledge vs. actual knowledge. One possible explanation for our lack of associations between these variables is our small sample size. The studies previously mentioned had a larger pool of participants ($n > 99$), whereas our intervention was much smaller ($n = 18$).

Finally, we found that the majority of the participants were not viewing the weekly blog post. The highest views were observed during week 1 and week 3 with an average of 32% views. On the contrary, weekly responses to text-messages were much higher with the highest being 80% response rate. Therefore it appears that despite the fact that no association was found between high text-message responders and FV consumption, text-messages and not the blogs might have had a greater influence on FV intake amongst the participants. Unfortunately, it is not possible to identify who exactly was viewing the blogs and therefore associations between the participants who viewed the blogs and their nutrition knowledge and cooking confidence scores cannot be assessed.

Having a relatively high text-message response rate is in accordance with the previous literature. One particular intervention that aimed to help individuals lose or maintain weight via a text-messaging component found that during the first week participants were responding to all of the text-messages and that by week-16 participants were responding to about two out of the three messages sent [133]. When considering the weekly blog views, it is hard to compare our findings with the previous literature. This is because we were not able to identify any previous interventions that have attempted to utilize a blog component as a method of delivering nutrition lessons. One particular study that was looking to assess the content and characteristics of

influential health blogs, found that half of the bloggers were employed in the health field, most blogged about one type of disease, and half were written from a professional perspective [134]. Another intervention used a blog component as a source of social support in individuals attempting to quit smoking and found that the blog was in fact beneficial [135]. However, in this intervention the blog posts were done by the participants and the purpose was to create conversation. Therefore, because the format and purpose of the blog utilized in that study were very different from the one presented in this intervention meaningful comparisons cannot be made.

We also hypothesized that increasing nutrition knowledge, self-efficacy, and cooking skills would result in an increase of the daily number of servings of FV that mothers of young children consume. Our study findings partially supported this conclusion. First, we observed that from the Food and Attitudes Behavior survey FV intake increased significantly from baseline to post-intervention. FV intake increased from 3 cups at baseline to 5 cups per day at post-intervention, thus FV intake increased by 2 cups. These findings are slightly greater than other eHealth interventions. A RCT by Chen et al., that aimed to measure the efficacy of a mobile intervention for overweight and obese adolescents found that FV intake in the intervention group increased from 3.0 servings to 3.76 servings of fruits and vegetables [105]. Another RCT found that a text-messaging program that promoted FV intake was able to increase FV consumption from 2.5 servings to about 3.5 servings in the intervention group [106].

Second, our results showed that there was no significant relationship between changes in nutrition knowledge and fruit and vegetable consumption. This is contrary to previous study findings. One study found that knowledge of the 5 A Day message was associated with a 22% increase in fruit and vegetable consumption [70]. Additionally, another study found that lack of

knowledge of the details of the 5 A Day message was associated with lower FV consumption [71]. A possible explanation for this finding is that the questionnaire utilized for nutrition knowledge did not precisely reflect the curriculum content. It is likely that if a measure was created specifically for the material covered in this intervention (one that accurately reflected content from MyPlate food groups, daily FV needs for mothers and young children, purchasing and storing FV, preparing FV, and modeling FV consumption), a stronger association would have been observed. Moreover, the previous literature appears to point to a specific relationship between knowledge of the FV guidelines and FV consumption and not just general nutrition knowledge [70, 71] thus as mentioned previously if the questionnaire had reflected specific content learned in the curriculum (which focused on FV knowledge) it is likely that a stronger association could have been observed. Therefore, it is possible that general nutrition knowledge is not one of the most important factors for increasing fruit and vegetable intake in mothers, but rather, learning *how* to increase FV is of greater value.

Finally, our results showed that there was in fact an association between cooking confidence and FV consumption. This is a finding that is in agreement with the previous literature. A recent pilot study found that cooking skills were associated with higher vegetable intake and food preparation frequency in a population of college-aged adults [82].

Beyond nutrition knowledge and cooking efficacy, additional factors that could be attributed to the increased daily intake of FV among the mothers are the goal setting and feedback components of the study. Previous studies have found that goal-setting can significantly affect FV intake. A 10-week web-based intervention found that setting goals significantly increased FV intake in a group of adults [136]. Further, a six-month RCT found that using a mobile food record and providing tailored feedback via text-messages was a promising way to increase FV intake in

adults [107] . Additionally, throughout the intervention mothers verbally stated the check-ins helped them feel accountable for their set goals, especially for their FV goals.

Finally, this pilot study provides evidence that utilizing a mobile intervention is a promising way to maintain participant adherence. Our results show that overall participant retention was 71%, which is higher than most face to face parental interventions. For example, in a study of mothers and their Pre-K children 68% retention rate was accomplished [137].

It is important to take into consideration that the population from this investigation was composed by individuals who were more likely to increase their FV intake when compared to the general public. This is the case for several reasons. First, the mothers started out with higher FV intake than the general public (~1.76 cups of vegetables and 1.38 cups of fruit for study participants vs. 1.6 cups of vegetables and 0.9 cups of fruit for the general American population [28]). Second, some studies have shown that women tend to have higher FV intake when they have higher levels of education and when they are older. The majority of our study participants were 30 to 39 years (60%) and had achieved either a Bachelor's (52%), and some form of a graduate level degree (28%). Thus, study findings must be interpreted with the study population in mind.

Strengths of this Study

There are some notable strengths to this study. First, is the innovative methodology used in this intervention. To our knowledge, this is the first study to utilize blogs, a Facebook page, and text-messaging components to increase maternal nutrition knowledge, cooking skills, and self-efficacy. Thus, findings from this study will contribute to the body of eHealth literature. Our findings help identify the feasibility and acceptability of using a web and mobile-based approach to increase daily servings of FV in the mothers of young children. Further, our findings identify

that using an online intervention is a promising way to help mothers build skills that will help them improve their dietary habits such as *how* to prepare healthy meals, *how* to increase fruits and vegetables throughout the day, *how* to include children in the food preparation process, and *how* to create a weekly menu and a budget-friendly grocery list. This study also helps future researchers identify that providing general nutrition knowledge than specific nutrition knowledge on FV is less effective when specifically aiming to improve FV intake. Instead, our findings suggest that providing specific knowledge and skills about FV, meal preparation, and other daily activities that mothers face is much more helpful and relevant. Finally, this study is a low-cost approach to target mothers of young children in a convenient and accessible way, and thus can help maintain participant adherence.

Limitations of this Study

There were a few limitations to this study. One is the small sample size that was relatively homogenous and thus inhibited our ability to reach power. Since the majority of participants were, white, well educated, and between the ages of 30 to 39, study findings cannot be attributed to other population groups outside of the sample. Further, all of the data reported, the nutrition assessments, FV intake, and cooking skills/confidence was self-reported. Thus, subjective bias for personal assessment of nutritional knowledge, cooking skills, and FV intake is likely to have occurred. Third, due to the lack of time and resources this investigation lacked a control group, thus conclusions about how much FV intake, cooking confidence, and skills were directly affected by the online intervention cannot be fully identified. Our pilot study, however, is contributing to the knowledge base about using mobile interventions to convey nutrition messages.

Implications for Future Research

To our knowledge, this study is the first to assess an online intervention for increasing nutrition knowledge, cooking confidence, and FV intake in mothers of young children. Findings from this study may provide information to researchers on the feasibility of utilizing tools such as blogs, Facebook, and text-messaging to increase maternal nutrition knowledge, cooking confidence, and FV intake. A more comprehensive intervention, such as a RCT with a large study population can be developed as a result of the study findings. Further, because this study stems from a larger investigation, Healthy Child Care Georgia (HCCG), study findings can help develop an online component for mothers of the preschoolers participating in HCCG. Increasing maternal cooking confidence, FV knowledge, and FV intake may be useful in helping preschoolers increase their exposure and willingness to try fruits and vegetables which is one of the outcomes of the HCCG program. Maternal involvement in the program may make the weekly curriculum of HCCG for the teachers more effective if parents are also actively participating in helping children build healthy behaviors and providing healthy snacks.

CHAPTER 6

CONCLUSION

In conclusion, mothers play a vital role in modeling healthy eating habits for their young children. However, many face to face interventions attempting to improve maternal health behaviors have had difficulty with participant adherence due to mothers' busy schedules. This investigation found that using a mobile intervention was a moderately feasible way to maintain maternal adherence at relatively high levels. Specifically, high adherence was observed for the text-messaging component, however, low adherence for weekly blog views was also observed. Out of the eighteen participants that completed the intervention sixteen of them were high-responders. Of notice, we did not find that text-message response rates were significantly associated with nutrition knowledge, cooking confidence, or FV consumption, however, the vast majority of the participants that were high responders did significantly increase their nutrition knowledge, cooking confidence, and FV intake. This finding suggests that a text-messaging component could be of use for future eHealth nutrition interventions. On the contrary, a blog intervention does not appear to be very beneficial. Thus, future investigations should utilize more efficacious mobile or online platforms to deliver nutrition education (such as a phone application).

Further, our findings showed that an online intervention is a feasible and acceptable way to significantly increase nutrition knowledge, cooking confidence skills, and FV intake amongst mothers of young children. Because the main objective of this intervention was to increase FV consumption in mothers of young children the results were very encouraging, especially

considering the significant increase of FV consumption. Further, mother's also perceived that the intervention was a feasible way to improve their nutrition knowledge, cooking confidence, and cooking skills.

In addition, we found that there was a significant association between increased cooking confidence and increased FV intake. On the contrary, we did not find a significant association between increased nutrition knowledge and increased FV consumption. This is a finding that helps future researchers identify that providing specific knowledge and skills about FV than general nutrition knowledge is more effective when specifically aiming to improve FV intake.

Overall, participants identified that the six most beneficial components of the intervention were as follows: 1) teaching FV portion sizes; 2) individual FV needs by age and activity levels; 3) knife techniques for FV; 4) menu planning development; 5) how to write a grocery list; and 6) providing healthy recipe ideas and tips on how to increase FV throughout the day. Further, mothers stated that they also benefited from creating goals, seeing actual examples of healthy meals, understanding FV servings, knowing which produce is in season, learning how to cook and meal plan for a balanced plate, child-friendly recipes, and the convenience and accessibility of the information. These findings are useful for future researchers aiming to increase FV consumption in mothers of young children. Specifically, this intervention outlines that a text-message component is useful and has high adherence rates. Further, our results imply that future studies should focus on specific FV knowledge rather than general nutrition knowledge. These findings can help inform the development of a randomized controlled trial that can precisely assess the specific impacts of eHealth interventions on maternal FV consumption.

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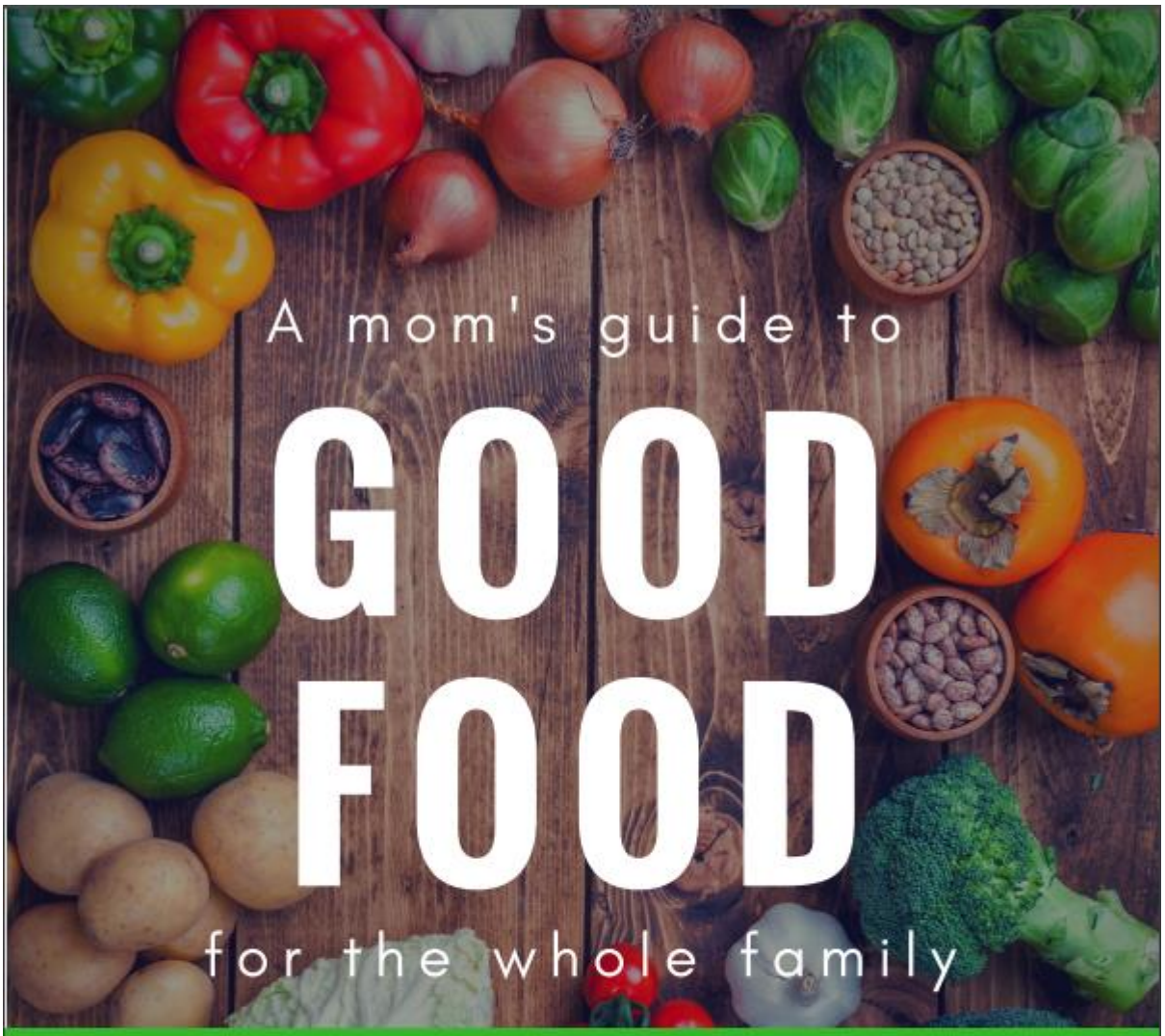
APPENDIX A

A MOBILE TECHNOLOGY INTERVENTION TO INCREASE MATERNAL FRUIT AND VEGETABLE CONSUMPTION: SALUBRIOUS SEED FLYERS



The Department of Foods and Nutrition at UGA is searching for mothers to participate in a 6-week online research study!

This program is designed for moms who have:

- -Children 0-5 years
- -A mobile phone with active data & text messaging services
- -Live in the Northeast Georgia region

Enter for a chance to win a $25 Amazon e-gift card. Your participation is not required in the study to be eligible to win the $25 Amazon e-gift card raffle.

Interested? e-mail Fabiola Jimenez at fdj47166@uga.edu. You can directly get access to the eligibility survey by scanning the QR code on the back page of this flyer!

COME JOIN US

Interested in participating in this research study?
Contact Fabiola Jimenez Meza at fdj47166@uga.edu
We will email you a direct link to an online survey that will test for your eligibility in this study.

We are looking for mothers 18-45 years who have a child that is between the ages of 0-5 years, a mobile phone with active data and text-messaging services, and who live in the Northeast Georgia region. Completion of the pretest surveys should take no more than 60 minutes to complete. The welcome kick-off session should take place from 60-90 minutes. Weekly lessons will take no more than 30 minutes of your day 3 days per week. Completion of the posttest surveys at the end of the 6 weeks will take no more than 60 minutes to complete.

THIS INTERVENTION WILL PROVIDE YOU WITH:

- Fun weekly lessons that include information on: nutrition, fruit/ vegetable needs and serving sizes, purchasing, storing, and preparing meals with fruits and veaetables
- Wholesome, budget friendly, and tasty recipes
- Tips on how to include children during cooking
- Recipes tailored for moms with young children

To find out more call (828) 557-6367 or email fdj47166@uga.edu. You can directly get access to the eligibility survey by scanning the QR code.

APPENDIX B

A MOBILE TECHNOLOGY INTERVENTION TO INCREASE MATERNAL FRUIT AND VEGETABLE CONSUMPTION: SALUBRIOUS SEED ELIGIBILITY SURVEY

Eligibility Survey for Salubrious Seed

Start of Block: Default Question Block

Q1 What is your gender?

- ○ Male (1)
- ○ Female (2)
- ○ Other (3)

Skip To: Q12 If What is your gender? = Male

Q2 Which category below includes your age?

- ○ 17 or younger (1)
- ○ 18-20 (2)
- ○ 21-29 (3)
- ○ 30-39 (4)
- ○ 40-45 (5)
- ○ 45 or older (6)

Skip To: Q12 If Which category below includes your age? = 45 or older
Skip To: Q12 If Which category below includes your age? = 17 or younger

Q3 What is the highest level of school you have completed or the highest degree you have received?

- ○ Less than high school degree (1)
- ○ High school degree or equivalent (GED) (2)
- ○ Some college, but no degree (3)
- ○ Associate degree (4)
- ○ Bachelor Degree (5)
- ○ Graduate Degree (6)

Q4 How much total combined money did members of your HOUSEHOLD earn last year?

- ○ $0-9,999 (1)
- ○ $10,000-24,999 (2)
- ○ $25,000-$49,9999 (3)
- ○ $50,000-$74,999 (4)
- ○ $75,000-$99,000 (5)
- ○ $100,000 and above (6)

Q5 Please indicate your race or ethnicity

- White (1)
- Black or African American (2)
- American Indian or Alaska Native (3)
- Asian (4)
- Native Hawaiian or Pacific Islander (5)
- Spanish, Hispanic, or Latino (6)
- Multiple races/ethnicity (7)

Q6 Do you have a child between the ages of 0-5 years?

- Yes (1)
- No (2)

Skip To: Q12 If Do you have a child between the ages of 0-5 years? = No

---

Q7 Do you own a smart phone with active data and text messaging services?

- Yes (1)
- No (2)

Skip To: Q12 If Do you own a smart phone with active data and text messaging services? = No

Q8 Do you have access to the Internet at home?

- ○ Yes (1)
- ○ No (2)

Q9 Have you been in a weight loss program or have made significant changes to your diet within the last 6 months?

- ○ Yes (1)
- ○ No (2)

Skip To: Q12 If Have you been in a weight loss program or have made significant changes to your diet within the l... = Yes

Q10 Do you live in the Northeast Georgia Region?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Do you live in the North East Georgia Region? = Yes

Q11 You are eligible for this study! If you wish to participate please provide your name followed by your email address

_____

Q12 Would you like to be entered to the raffle to win a $25 amazon e-gift card?

- Yes (1)
- No (2)

Display This Question:

If Would you like to be entered to the raffle to win a $25 amazon e-gift card? = Yes

Q13 If you have not already done so, please provide your name and email for the raffle (anyone who took part in the survey can enter the raffle)

_____

APPENDIX C

FOOD ATTITUDES AND BEHAVIOR SURVEY

Food Attitudes and Behavior Survey

Start of Block: The following provides examples of how much counts as one cup of fruit:

Q6 First and last name

_____

Q1 **1 cup of fruit could be:**

1 small apple

1 large banana

1 large orange

8 large strawberries

1 medium pear

2 large plums

1 cup (8 oz) of 100% fruit juice

1 small wedge of watermelon (~1" thick)

Q2 About how many cups of FRUIT do you eat or drink each day? (choose one)

- None (1)
- 1/2 cup or less (2)
- 1/2 -1 cup (3)
- 1-2 cups (4)
- 2-3 cups (5)
- 3-4 cups (6)
- 4 cups or more (7)

Q5 **1 cup of vegetables could be:**

1 cup of cooked leafy greens

2 cups of lettuce raw or raw greens

12 baby carrots

1 medium potato

1 large ear of corn

1 large raw tomato

2 large celery stalks

1 cup of cooked beans

Q3 About how many cups of VEGETABLES do you eat or drink each day? (choose one)

- ○ None (1)
- ○ 1/2 cup or less (2)
- ○ 1/2-1 cup (3)
- ○ 1-2 cups (4)
- ○ 2-3 cups (5)
- ○ 3-4 cups (6)
- ○ 4 cups or more (7)

End of Block: The following provides examples of how much counts as one cup of fruit:

APPENDIX D

COOKING ATTITUDES AND BEHAVIOR SURVEY

Cooking Attitudes and Behavior Survey

Indicate the extent to which you feel confident about performing each of the following activities...

	Not at all confident (1)	Not very confident (2)	Neutral (3)	Confident (4)	Extremely Confident (5)
Using knife skills (1)	○	○	○	○	○
Using basic cooking techniques (2)	○	○	○	○	○
Steaming (3)	○	○	○	○	○
Sautéing (4)	○	○	○	○	○
Stir-frying (5)	○	○	○	○	○
Grilling (6)	○	○	○	○	○
Poaching (7)	○	○	○	○	○
Baking (8)	○	○	○	○	○
Roasting (9)	○	○	○	○	○

Stewing (10)	○	○	○	○	○
Preparing fresh or frozen vegetables (eg broccoli, spinach) (11)	○	○	○	○	○
Preparing root vegetables (eg potatoes, beets, sweet potatoes) (12)	○	○	○	○	○
Preparing fruit (peaches, watermelon) (13)	○	○	○	○	○
Using herbs and spices (eg basil, thyme,	○	○	○	○	○

cayenne pepper) (14)					
Preparing food from a recipe (15)	○	○	○	○	○

APPENDIX E

GENERAL NUTRITION KNOWLEDGE QUESTIONNAIRE

General Nutrition Knowledge Questionnaire for Adults

Start of Block: Food Classification

First and last name

_____

Q1 Do you think these are high or low in added sugar? (tick one box per food)

	High (1)	Low (2)	Not Sure (3)
Bananas (1)	○	○	○
Greek Yogurt (No flavor) (2)	○	○	○
Ice-cream (3)	○	○	○
Fruit Juice (4)	○	○	○
Tomato Ketchup (5)	○	○	○

Q2 Do you think these are high or low in fat? (tick one box per food)

	High (1)	Low (2)	Not sure (3)
Pasta (without sauce) (1)	○	○	○
Black beans (2)	○	○	○
Luncheon meat (3)	○	○	○
Honey (4)	○	○	○
Eggs (5)	○	○	○
Biscuit (6)	○	○	○
Parmesan Cheese (7)	○	○	○

Q3 Do you think these are high or low in salt? (tick one box per food)

	High (1)	Low (2)	Not Sure (3)
Breakfast Sausages (1)	○	○	○
Bread (2)	○	○	○
Pasta (3)	○	○	○
Frozen vegetables (4)	○	○	○
Cheese (5)	○	○	○
Soy Sauce (6)	○	○	○

Q4 Do you think these are high or low in protein? (tick one box per food)

	High (1)	Low (2)	Not Sure (3)
Chicken (1)	○	○	○
Cheese (2)	○	○	○
Fruit (3)	○	○	○
Lentils (4)	○	○	○
Yogurt (5)	○	○	○

Q5 Do you think these are high or low in fiber? (tick one box)

	High (1)	Low (2)	Not sure (3)
Cheerios (1)	○	○	○
Bananas (2)	○	○	○
Red meat (3)	○	○	○
Broccoli (4)	○	○	○
Baked potato with skin (5)	○	○	○
Oatmeal (6)	○	○	○

Q6 Do you think these fatty foods are high or low in saturated fat? (tick one box per food)

	High (1)	Low (2)	Not Sure (3)
Salmon (1)	○	○	○
Nuts (2)	○	○	○
Whole milk (3)	○	○	○
Olive Oil (4)	○	○	○
Ice-Cream (5)	○	○	○

Q7 Which of the following do nutrition experts call "a healthy alternative to red meat"? (tick one box per food)

	Yes (1)	No (2)	Maybe (3)
Chicken (1)	○	○	○
Fish (2)	○	○	○
Luncheon meat (3)	○	○	○
Black beans (4)	○	○	○
Nuts (5)	○	○	○
Low fat cheese (6)	○	○	○

Q8 There is more protein in a glass of whole milk than a glass of skimmed milk?

- ○ Agree (1)
- ○ Disagree (2)
- ○ Not Sure (3)

Q9 Which of these breads contain the most vitamins and minerals?

- White (1)
- Whole grain (2)
- Not Sure (3)

Q10 This is a type of oil which contains mostly unsaturated fats:

- Coconut oil (1)
- Sunflower oil (2)
- Oliver oil (3)
- Palm oil (4)
- Not sure (5)

Q11 There is more calcium in a glass of whole milk than a glass of skimmed milk

- Agree (1)
- Disagree (2)
- Not sure (3)

Q12 Harder fats contain more:

- ○ Monounsaturated fats (1)
- ○ Polyunsaturated fats (2)
- ○ Saturated fats (3)
- ○ Not Sure (4)

Q13 Polyunsaturated fats are mainly found in:

- ○ Vegetable oils (1)
- ○ Dairy products (2)
- ○ Both a and b (3)
- ○ Not sure (4)

End of Block: Food Classification

Start of Block: Health Problems and Diseases

Q15 Are you aware of any major problems or diseases that are related to low intake of fruits and vegetables?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Are you aware of any major problems or diseases that are related to low intake of fruits and vege... = Yes

Q16 What diseases or health problems do you think are related to low intake of fruits and vegetables?

_____

Q17 Are you aware of any major problems or diseases that are related to low intake of fiber?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Are you aware of any major problems or diseases that are related to low intake of fiber? = Yes

Q18 What diseases or health problems do you think are related to low intake of fiber?

_____

Q19 Are you aware of any major problems or diseases that are related to how much sugar people eat?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Are you aware of any major problems or diseases that are related to how much sugar people eat? = Yes

Q20 What diseases or health problems do you think are related to sugar/

_____

Q21 Are you aware of any major problems or diseases that are related to how much salt people eat?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Are you aware of any major problems or diseases that are related to how much salt people eat? = Yes

Q22 What diseases or health problems do you think are related to salt?

_____

Q23 Are you aware of any major health problems or diseases that are related to the amount of fat people eat?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Are you aware of any major health problems or diseases that are related to the amount of fat peop... = Yes

Q24 What diseases or health problems do you think are related to fat?

_____

Q25 Do you think these help reduce the chances of getting certain kinds of cancer?

	Yes (1)	No (2)	Not Sure (3)
Eating more fiber (1)	○	○	○
Eating less sugar (2)	○	○	○
Easing less fruit (3)	○	○	○
Eating less salt (4)	○	○	○

Q26 Do you think these help prevent heart disease?

	Yes (1)	No (2)	Not Sure (3)
Eating more fiber (1)	○	○	○
Eating less sugar (2)	○	○	○
Eating less fruit (3)	○	○	○
Eating less salt (4)	○	○	○

End of Block: Health Problems and Diseases

APPENDIX F

A MOBILE TECHNOLOGY INTERVENTION TO INCREASE MATERNAL FRUIT AND VEGETABLE CONSUMPTION: WEEKLY FEASIBILITY AND ACCEPTABILITY SURVEY

Feasibility and Acceptability for Week 5

Start of Block: Default Question Block

Q1 Did this week's lesson increase your knowledge about healthy food?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this week's lesson increase your knowledge about healthy food? = Yes

Q2 Please explain how this lesson helped to increase your food knowledge?

_____

Display This Question:

If Did this week's lesson increase your knowledge about healthy food? = No

Q4 Please describe other methods that would have helped to increase your nutrition knowledge?

Q3 Did this week's lesson increase your skills to prepare healthy foods?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this week's lesson increase your skills to prepare healthy foods? = Yes

Q5 Please explain how this lesson helped to increase your cooking skills?

_____

Display This Question:

If Did this week's lesson increase your skills to prepare healthy foods? = No

Q6 Please describe other methods that would help to increase your cooking skills?

_____

Q7 Did this lesson increase your confidence to prepare healthy foods?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this lesson increase your confidence to prepare healthy foods? = Yes

Q8 Please explain how this lesson helped to increase your confidence to prepare healthy foods?

_____

Display This Question:

If Did this lesson increase your confidence to prepare healthy foods? = No

Q9 Please describe other methods that would have helped to increase your confidence to prepare healthy foods?

_____

Q10 Please identify overall weaknesses of the weekly lesson

_____

Q11 Please identify overall strengths of the weekly lesson

_____

APPENDIX G

A MOBILE TECHNOLOGY INTERVENTION TO INCREASE MATERNAL FRUIT AND VEGETABLE CONSUMPTION: OVERALL FEASIBILITY AND ACCEPTABILITY SURVEY

Feasibility and Acceptability of Overall Program

Start of Block: Default Question Block

Q1 Did this 6-week intervention increase your knowledge about healthy food?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this 6-week intervention increase your knowledge about healthy food? = Yes

Q2 Please explain how this intervention helped to increase your food knowledge?

_____

Display This Question:

If Did this 6-week intervention increase your knowledge about healthy food? = No

Q3 Please describe other methods that would have helped to increase your nutrition knowledge?

_____

Q4 Did this 6-week intervention increase your skills to prepare healthy foods?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this 6-week intervention increase your skills to prepare healthy foods? = Yes

Q5 Please explain how this intervention helped to increase your cooking skills?

_____

Display This Question:

If Did this 6-week intervention increase your skills to prepare healthy foods? = No

Q6 Please describe other methods that would help to increase your cooking skills?

_____

Q7 Did this 6-week intervention increase your confidence to prepare healthy foods?

- ○ Yes (1)
- ○ No (2)

Display This Question:

If Did this 6-week intervention increase your confidence to prepare healthy foods? = Yes

Q8 Please explain how this intervention helped to increase your confidence to prepare healthy foods?

_____

Display This Question:

If Did this 6-week intervention increase your confidence to prepare healthy foods? = No

Q9 Please describe other methods that would have helped to increase your confidence to prepare healthy foods?

_____

Q10 Were the weekly 5$ credit for Amazon e-gift cards an incentive for you to meet your weekly goals?

_____

Q11 Please identify overall weaknesses of the weekly lesson

_____

Q12 Please identify overall strengths of the weekly lesson

_____

End of Block: Default Question Block